**Effect of FIR athletic apparel on oxygen consumption during exercise**

Jay T Worobets PhD, Emma R Skolnik MKin, Darren J Stefanyshyn PhD

Human Performance Lab, Faculty of Kinesiology, University of Calgary

---

### INTRODUCTION

Far infrared (FIR) radiation (λ=3-100 μm) is considered a promising treatment modality for certain medical conditions. [1-4] FIR emitting ceramic nanoparticles can be impregnated into fibers, then woven into fabrics and made into apparel.

If such apparel are capable of inducing positive physiological effects, then there may be important implications when worn by athletes during exercise and/or competition. The purpose of this study was to examine whether FIR radiating athletic apparel had an effect on oxygen consumption during cycling at submaximal intensities.

### METHODS

Twelve aerobically fit male recreational cyclists participated in the study. Each subject completed four submaximal incremental cycling tests; twice while wearing a full body Control garment, twice while wearing a similar garment made out of FIR radiating fabric. Tests were done at least 48 hours apart, apparel condition test order was randomized for each subject.

The test began with cycling at a relatively low intensity (< 150 W). Cycling workload was then increased by 25 W every two minutes, while cadence remained constant (digital feedback was provided). The test ended when the subject’s blood lactate concentration exceeded 6 mmol/L.

Oxygen uptake was recorded throughout the entire test. Blood samples were taken 10 seconds prior to the end of each workload stage.

Blood lactate concentration data were used to estimate the times at which each subject exceeded 2 mmol/L, 4 mmol/L, and 6 mmol/L. The volume of oxygen consumed in each of three intervals (<2, 2-4, 4-6 mmol/L) were calculated and compared between apparel conditions.

### RESULTS

<table>
<thead>
<tr>
<th>Interval [L]</th>
<th>n=12</th>
<th>Control</th>
<th>FIR</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 2 mmol/L</td>
<td>15.48 L</td>
<td>15.31 L</td>
<td>p-value: &lt; 0.05</td>
</tr>
<tr>
<td>2 - 4 mmol/L</td>
<td>11.87 L</td>
<td>11.76 L</td>
<td>p-value: &lt; 0.05</td>
</tr>
<tr>
<td>4 - 6 mmol/L</td>
<td>8.94 L</td>
<td>8.90 L</td>
<td>p-value: &gt; 0.51</td>
</tr>
</tbody>
</table>

Example data: Subject 1: Trial 1

<table>
<thead>
<tr>
<th>VO₂ [L/min]</th>
<th>Blood Lactate Concentration [mmol/L]</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>&lt; 2 mmol/L</td>
</tr>
<tr>
<td>4</td>
<td>2 - 4 mmol/L</td>
</tr>
<tr>
<td>6</td>
<td>4 - 6 mmol/L</td>
</tr>
<tr>
<td>8</td>
<td>---</td>
</tr>
</tbody>
</table>

---

### DISCUSSION & CONCLUSION

The FIR radiating apparel caused the subjects to consume less oxygen when cycling at lower intensities (blood lactate concentration < 4 mmol/L), but did not have an effect when cycling at higher intensities (> 4 mmol/L).

On average, the decrease in oxygen consumption was approximately 1.0%.

If this effect were present at an intensity corresponding to a cyclist’s endurance race pace, then FIR radiating apparel may enhance performance during competition. However, further investigation is required to verify or refute this.

### REFERENCES


### ACKNOWLEDGEMENTS

Support for this study was provided by Hologenix LLC & adidas International